Canam Technology, Inc. Comments regarding FCC Public Notice on Signal Boosters

REF: FCC DA 10-14
WT Docket No. 10-4

WIRELESS TELECOMMUNICATIONS BUREAU SEEKS COMMENT ON PETITIONS REGARDING THE USE OF SIGNAL BOOSTERS AND OTHER SIGNAL AMPLIFICATION TECHNIQUES USED WITH WIRELESS SERVICES

These comments are related to 47CFR Part 90 Signal Boosters, as defined in 90.7, mainly those intended for Public Safety services.

1) **POTENTIAL** OF CAUSING HARMFUL INTERFERENCE:

Since the rules adoption in 1996 **FCC Report and Order 96-223**, the FCC has recognized the Class B boosters' potential for causing harmful interference:

> **"17.** Decision. As noted in the comments, Class B broadband boosters raise additional interference concerns. These devices amplify all signals within the design passband, including signals on frequencies that may not be authorized to the licensee. Nevertheless, the comments contend there is a need for Class B broadband boosters. Therefore, rather than prohibit their use, we will restrict use of Class B broadband boosters under Parts 22, 90 and 94 to areas that are confined or enclosed such as tunnels, underground parking garages, and within buildings (*i.e.*, areas where there is little or no risk of interference to others). This provision, along with the requirement that licensees must correct any interference caused by signal boosters, should alleviate interference concerns about the use of Class B broadband signal boosters."

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Consequently, the FCC issued rule 90.219(d) restricting the use of broadband boosters to "areas that are confined or enclosed". However, there are thousands of broadband signal boosters, a.k.a. "BDAs", currently deployed for Part90 services, as recognized by some of the here Petitioners, that are transmitting uplink signals over-the-air in open outdoor spaces, arguing that just because the booster is used to provide coverage in an enclosed area they have been presuming the FCC did not restrict they could transmit outdoors to link back with the donor site.

Back in 1997, the FCC did deny a TxRx Systems (now part of Bird Technologies Group) Petition for Reconsideration to allow the use of broadband signal boosters to transmit outdoors. See **FCC MEMORANDUM OPINION AND ORDER #97-167:**

> "We concluded that this use restriction along with the general requirement for licensees employing boosters to correct interference were measures designed to address interference concerns raised by commenters.[1] TX RX has provided no new or additional information which warrants our elimination of the operation restriction on Class B boosters. Further, if as TX RX notes, authorizing boosters by rule will increase their use, there is even a greater need to restrict Class B boosters to minimize interference.
>
> As for the issue of existing users having to replace equipment, we note that our records indicate that no rule waivers to use boosters in the 800 and 900 MHz bands have been granted. Therefore, there should be no Class B boosters operating in the 800 and 900 MHz SMR bands and consequently, no need for licensees to replace equipment. Accordingly, we are retaining the limitations in 47 C.F.R. 90.219(d) and 101.151(d) that Class B boosters may only be used in confined or enclosed areas. "

However, several Part90 services, including Public Safety Entities and Government Agencies have continued using broadband boosters that transmit outdoors for over the air uplink, now having grown up from the five

[1] *Report and Order*, 11 FCC Rcd at 16628.

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hundreds admitted by TxRx in his 1997 Petition, to the thousands they now say.

As a result of that "apparent" lack of clarity on the 90.219(d) rule, and in view of the market reality of the spread use of BDAs transmitting outdoors for Part90 services, we did seek a Clarification from the FCC Wireless Telecommunications Bureau in May 2005, getting the next page response from the Chief of Public Safety and Critical Infrastructure Division:

> "Class B boosters cannot be used for a communications link that emits radio frequency energy outside a confined area i.e., designed to be a communications link between a confined area and a base station as described in the attachment to your letter. Allowing this type of operation would increase the interference potential to other users in the area, especially what the Commission was trying to avoid when restricted Class B boosters to confined areas."

Once again, however, most Part90 Public Safety Agencies and Other Commercial Services still keep using broadband boosters in that fashion, and the FCC seems not reinforcing the rule application.

The potential for causing harmful interference has increased due to the widespread use of broadband boosters. During the day-to-day routine, the issues may go undetected or not appear, but a real crisis emergency situation could be catastrophic. The Public Safety Radio coverage in enclosed or confined spaces is mission-critical and should not be compromised, most importantly should be fully reliable in the worst-case of a real crisis with a crowded First-Responders scene of everybody trying to communicate over the radio.

Therefore, we suggest the FCC to further clarify 90.219(d) rule as stated by Chief Wilhelm in June 2005.

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Federal Communications Commission
Washington, D.C. 20554

June 6, 2005

This is in reply to your March 9, 2005, letter concerning an interpretation of Part 90 of the Commission's rules applicable to signal boosters. You state that one of your clients markets bi-directional radio amplifiers (*i.e.,* Class A and Class B signal boosters) for use in tunnels, large buildings and other confined locations in urban areas. You note, that when bidding on projects where signal boosters are needed, your client's proposals specify Class B boosters for communications inside confined areas but specify a Class A booster for the communications link from the confined area back to a base station (*i.e.,* what you refer to as the above-ground link or uplink/downlink in your example). Your client specifies the Class A booster for the above-ground link because it is your client's understanding that the Commission's rules prohibit using Class B boosters for this link.

However, you assert that other vendors bidding on the same projects as your client routinely specify a Class B booster for this back-to-the-base-station communications link because Class B boosters are less expensive than Class A boosters. You state that the end result of this is that your client may not be awarded a contract because it is not the low bidder. You seek clarification of whether the Commission's rules permit Class B signal boosters to be used in an urban area to provide a communications link that is designed to transmit communications outside a confined area, in this case to relay communications from the confined area back to a base station.

In 1996 the Commission amended its rules to allow for the general use of signal boosters under Part 90 (*i.e.,* routinely allow devices that receive incoming signals, amplify the signals and then retransmit them). The Commission allowed signal boosters in order to provide licensees a more cost effective method of improving system coverage (*e.g.,* to fill in weak or no signal areas that may be present in a licensee's area of operation). In adopting rules governing signal boosters, the Commission specified two types of signal boosters – Class A boosters (sometimes referred to as narrowband boosters since they are designed to amplify only those discrete frequencies intended to be retransmitted) and Class B boosters (sometimes referred to as broadband boosters since they amplify all frequencies that are received within the booster's passband). *See* 47 C.F.R. §§ 90.7 and 90.219.

In allowing Class B boosters, the Commission noted the increased interference potential inherent in such devices. To minimize interference, the Commission limited Class B signal boosters to areas that are confined or enclosed (confined areas) such as tunnels, underground parking garages and within buildings *i.e.,* areas where there is little or no risk of interference to others. *See* 47 C.F.R. § 90.219(d). Therefore, Class B boosters cannot be used for a communications link that emits radio frequency energy outside a confined area *i.e.,* designed to be a communications link between a confined area and a base station as described in the attachment to your letter. Allowing this type of operation would increase the interference potential to other users in the area, specifically what the Commission was trying to avoid when it restricted Class B boosters to confined areas.

I trust this is responsive to your inquiry.

FEDRAL COMMUNICATIONS COMMISSION

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2) FEDERAL REGISTER DISCREPANCY WITH FCC REPORT AND ORDER #96-223:

The 47CFR Part90.219(d) rule being officially reported by the US Federal Register differs from the literal FCC Report and Order #96-223, which is another matter of confusion among the Part90 Services.

The Federal Register and the Electronic Code of Federal Regulations state Class B boosters could also be used "in remote areas":

> "(d) Class B broadband signal boosters are permitted to be used only in confined or indoor areas such as buildings, tunnels, underground areas, etc., **or in remote areas**, i.e., areas where there is little or no risk of interference to other users.

http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=054350bf10a8a810d4996f7f0d7bfa25&rgn=div8&view=text&node=47:5.0.1.1.3.8.111.12&idno=47

However, the official FCC order #96-223 does not have those words:

> (d) Class B broadband signal boosters are permitted to be used only in confined or indoor areas such as buildings, tunnels, underground areas, etc., *i.e.*, areas where there is little or no risk of interference to other users.

This contradiction was addressed by the cited FCC Memorandum #97-167 as follows:

> " 8. Finally, TX RX states that pursuant to the *Report and Order,* the use of Class B boosters is permitted not only in confined areas, but also in remote areas, and that it is unclear as to what constitutes a remote area.[2] We disagree with TX RX's characterization of our decision. There is no reference in the *Report and Order* or Section 90.219(d) of the Commission's rules

[2] *Id.* at 6.

> regarding the use of Class B boosters in remote areas.[3] Thus, we conclude that clarification of the term "remote areas" is unnecessary. Moreover, we consider Section 90.219(d) of our rules to be clear as to where a Class B booster may be used."

Therefore, we suggest the FCC to maintain the restriction in remote areas and amend the Federal Register contradiction.

3) CLASS-A NARROWBAND SIGNAL BOOSTER DEFINITION versus "Laws-of-Physics" practical limitations:

We have experienced many Part90 licensees have been hesitant of using Class-A narrowband boosters because the higher Absolute Group Delay required by the narrower channel filters may cause distortion in the overlap coverage areas between the indoor retransmitted signal and the original one off-air.

This is also known as Time Delay Interference (TDI) and affects services with digital modulation protocols if the multi-path signals delay in those overlap areas is above the 35-40 microseconds range, or for analog modulations if the delay is above the 120 microseconds range.

By "laws-of-physics", the narrower the filter the higher the Absolute Group Delay (Throughout Signal Delay or Phase Change from input to output).

Since part 90.7 defines Class-A Narrowband Signal Booster as one that "amplifies only those discrete frequencies intended to be retransmitted", and part 90.219(c) mandates "Class A narrowband boosters must meet the out-of-band emission limits of 90.209 for each narrowband channel that the booster is designed to amplify", some manufacturers and End-Users have been requesting the booster should have channel passband filters with an

[3] Section 90.219(d), as adopted, states "Class B broadband boosters are permitted to be used only in confined or indoor areas such as buildings, tunnels, underground areas, etc., *i.e.*, areas where there is little or no risk of interference to other users".

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amplitude vs. frequency response that fits within the corresponding 90.209 Emissions Mask corresponding to the licensed channel being amplified.

This imposes a very severe penalty on the channel filter delay, which makes the narrowband booster to be impractical in most cases.

For example, an Infinity-Impulse-Response (IIR) type filter response that fits within the 12.5 kHz channels Emissions Mask-D has a Delay in the order of 120 microseconds, which is completely useless or unfeasible for digital modulations in overlap coverage areas (booster versus off-air signals). The IIR-type filters do offer the lower group delay but at the expense of much higher Group Delay Variation (GDV) or ripple across the passband, which is not good either for intensive phase-based digital modulations. The alternative would be to use Finite-Impulse-Response (FIR) type filters that exhibit very low ripple or practically no phase change (flat group delay), but the Absolute Group Delay for an equivalent filter response is much higher than the IIR-type.

Thinking on fitting the 6.25 kHz emissions mask is even worst.

However, we believe the cited 90.7 and 90.219(c) paragraphs are being misinterpreted in the sense that it is not necessary for the Class-A narrowband booster filters to fit in the Emission Masks in order to comply with both rules. For example, let us examine this case:

a) A signal booster is equipped with several narrowband filters, each one having a pass bandwidth of 60 kHz and >60 dB rejection at 75 kHz offset from each filter center frequency, in order to have a practical group delay in the order of 30 microseconds. Of course, this filter shape is much wider than the 90.209 B or D Emission Masks for 25 and 12.5 kHz channels, respectively.
b) The filters will be tuned only to the Licensed End-User channels. No other channel frequencies will be programmed.
c) The booster may comply with the part 90.7 definition if:
    1) There are no other licensees in the area in the adjacent channels, thus the booster will not amplify someone else channels because there are no neighbors.

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2) Some adjacent channels are licensed in the area but they belong to the same licensee, thus they are part of "those discrete frequencies intended to be retransmitted", as defined by part 90.7. This is the case when an Agency is granted two or more contiguous channels.
3) Some adjacent channels are licensed to others in the area, but all involved licensees whose channels may pass thru the narrow filters do agree to share the booster and allow its channels to be retransmitted.

d) The booster does comply with part 90.209(c) as long as it meets "the out-of-band emission limits of 90.209 for each narrowband channel that the booster is designed to amplify." Since a signal booster could be modeled as a filtered amplifier, the **output emissions** are a function of the input emissions, given the booster does not alter or add distortion, shift or spurs to the input signal.

Therefore, if the booster reproduces the input signal with no significant change in its spectral integrity, its output will meet the emission mask because the signal on the air already did it, since it is being emitted by a compliant base or mobile transmitter. The FCC TCB Certification Labs will verify this by ensuring the booster output complies with the corresponding emission mask, no RF energy is above the mask, even though the booster filter pass bandwidth could be slightly higher than the mask.

Narrowband Signal Boosters with filters pass bandwidths in the order of 100 kHz are much better than up to 18-Megahertz fully broadband ones, for the FCC and the Public Safety interest of preventing the potential of harmful interference.

Therefore, we suggest the FCC to clarify the Class-A Narrowband Signal Boosters filters amplitude vs. frequency response curves are not required to fit within the emission mask of the licensed channels intended to be retransmitted, as long as the booster complies with the 90.7 definition and the 90.219(c) emission limits.

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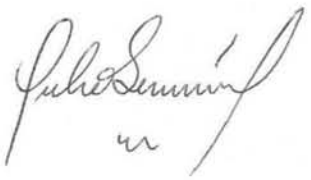
Furthermore, we suggest the FCC to clarify several licensees could share a common signal booster equipment or infrastructure, as long as the booster retransmits only the licensees' frequencies, or a single licensee with several adjacent channels could use a filter passing thru two or more of its channels together.

By Canam Technology, Inc.



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